U. S. DEPARTMENT OF AGRICULTURE
Farmers' Bulletin No. 907 Rev. 11/17 + 6/22

BEAN GROWING

In Eastern Washington and Oregon and Northern Idaho

LEE W. FLUHARTY
Assistant Agriculturist
Office of Farm Management and Farm Economics

Revised by

BYRON HUNTER
Agriculturist

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1922

BEAN GROWING can be successfully conducted in certain localities of eastern Washington and Oregon and northern Idaho, without seriously interfering with the major industry of that section—wheat growing.

In fact, in that section, there are thousands of acres lying idle as summer fallow which are well adapted to bean growing and at slight additional expense with practically the same equipment can be made to produce 800 pounds of beans per acre, which at present prices affords no small addition to the farmers' receipts.

This bulletin describes the methods followed by the most successful bean growers, showing that, where moisture for crop production is present and no frosts occur between May 10 and September 15, beans have been incorporated in the cropping system with profit.

Washington, D. C.

Issued December, 1913, as No. 561
Revised November, 1917
Slightly revised June, 1922

BEAN GROWING IN EASTERN WASHINGTON AND OREGON, AND NORTHERN IDAHO.

CONTENTS.

AREA SUITED TO CROP.

THE ARABLE LAND of eastern Washington, eastern Oregon, and northern Idaho has been devoted almost exclusively to the production of wheat, oats, and barley for more than 30 years. Because of the introduction of serious weed pests soon after the land was brought into cultivation it was found unprofitable to grow a crop of grain each year. Many of the new settlers had come from the Willamette Valley, Oreg., where wheat and oats were grown by summer-fallowing the land every second or third year. Hence, they naturally turned to that system of farming as a solution of their weed problem, and the growing of small grain by the summer-fallow method is still the general practice among the farmers of this region. Under this system of farming from one-third to one-half of the land lies idle each season.

Wheat, oats, and barley are the crops most universally grown there, yet a portion of the region is well adapted to the production of beans. The area best suited to this crop lies along the foothills of the Blue Mountains in Umatilla County, Oreg., Walla Walla, Columbia, Garfield, and Asotin Counties, Wash., and along the foothills of the Craig Mountains and adjacent to the canyons of the Clearwater and Potlatch Rivers in Nez Perce, Lewis, and Latah Counties, Idaho. There are a few districts in Whitman, Spokane, and Stevens Counties, Wash., also, where the climatic conditions are favorable for bean culture. While it is true that only a limited area is especially adapted to this crop, a careful study of all the details of its production shows that there are thousands of acres now lying idle each year as summer

fallow which might be used for growing beans as an intertilled crop. This crop has been grown in parts of Nez Perce and Latah Counties, Idaho, for the past 20 years, and the bean hullers make their regular fall runs the same as the grain thrashers. The crop has also been grown in a more limited way near Weston, Oreg., for about 20 years. The production of field beans in this territory is therefore past the experimental stage. A few days spent in the vicinity of Kendrick, Idaho, visiting bean growers during the months of July and August will convince the skeptical of this fact.

FACTORS FAVORING BEAN PRODUCTION.

Two factors largely determine where beans may be grown successfully: (1) The annual precipitation must be sufficient to produce a crop each year and (2) the growing season from May 10 to September 15 must be approximately free from frosts. Owing to their proximity to the mountains the districts previously mentioned receive sufficient precipitation for growing beans where proper cultural methods are employed.

The deep ravines leading down from the mountains in these regions give protection from frosts during the growing season by furnishing excellent air drainage. While the danger from frosts increases with the elevation, air drainage is the principal regulating factor. In parts of Nez Perce County, Idaho, where the deep canyons furnish good air drainage, beans are being grown successfully at an elevation of 3,000 feet. In other parts of the same county having a lower elevation but poor air drainage, this crop can not be grown on account of the late spring and early autumn frosts.

Three factors which are within the control of the farmer affect success of the bean crop, namely, the quantity of moisture stored in the soil at the time of planting, the methods employed in growing and harvesting the crop, and the presence of the nodule-forming bacteria in the soil. It is the purpose of this bulletin (1) to encourage bean culture in those localities that have a frost-free season of sufficient length to insure maturity and have enough rainfall to grow beans on land that usually lies idle as summer fallow, (2) to discuss in detail the cultural methods which have been worked out during the past 20 years by the most successful farmers in the bean-growing districts, and (3) to give directions for supplying the soil with nodule-forming bacteria.

METHODS USED IN BEAN PRODUCTION.

The success of the bean crop depends largely upon the thorough preparation of the seed bed. The work of preparation should begin in the early autumn. The most successful growers work the grain

stubble into the soil with a sharp disk harrow soon after the coming of the first fall rains. After such treatment plowing evenly distributes the stubble throughout the soil, where it quickly decays and prevents packing. It may not always be possible to disk the stubble in the fall because of the rush of work at that season. If, however, the plowing is to be delayed until the following spring, fall disking is even more necessary.

FALL PLOWING.

Land that is to produce a crop of beans should be plowed to a depth of 6 or 8 inches in the fall soon after the soil becomes damp enough to be worked, or at the latest in the early winter. It is then allowed to lie until early spring in the rough state as left by the plow. Thus the winter's precipitation is absorbed by the soil instead of being lost by running off, as is frequently the case with much of the rainfall when the land lies as a stubble field during the winter. When dry enough in the spring the soil is stirred once or twice with a disk or other suitable implement and then harrowed. A dry earth mulch is maintained until planting time for the purpose of retaining soil moisture and destroying weeds. This generally requires from three to four cultivations at intervals of 8 or 10 days. The use of the packer is not usually necessary after fall plowing, as the winter rains and numerous spring cultivations firm the soil sufficiently.

SPRING PLOWING.

Although plowing in the fall or early winter is preferable, it is sometimes done in the spring as soon as the ground is in condition to be worked. When the plowing is postponed the land should have been disked the previous fall. Fall disking works the stubble into the soil and puts the ground in condition to catch and retain the winter's moisture. Cultivation is begun immediately after plowing for the purpose of firming the seed bed, checking evaporation, and inducing the germination of weed seed. The harrow must follow not more than one-half day behind the plow. Some farmers attach a section of a harrow to the gang plow and perform the two operations at the same time. A subsurface packer is sometimes used for the purpose of firming the soil and reestablishing capillarity. If used, the packer is run immediately behind the plow, and it in turn is followed closely by a drag harrow. The land is then handled until seeding time in the same manner as the fall-plowed ground. Plowing must never be delayed until late spring, for that permits the soil to become so dry that it breaks up in hard clods and much extra labor is necessary in preparing a suitable seed bed.

PLANTING THE BEAN CROP.

Time to plant.—The time of planting varies from May 10 to June 5, according as the season is early or late. When planted too early, cold weather, together with an excessive quantity of moisture in the soil, often causes the seed to decay before germination begins. Even if a good stand is secured under such unfavorable conditions the crop usually develops and ripens very unevenly.

Method of planting.—If the land to be planted is comparatively level and free from weeds and there is sufficient rainfall, the largest yields are secured by planting the beans in rows 28 inches apart and

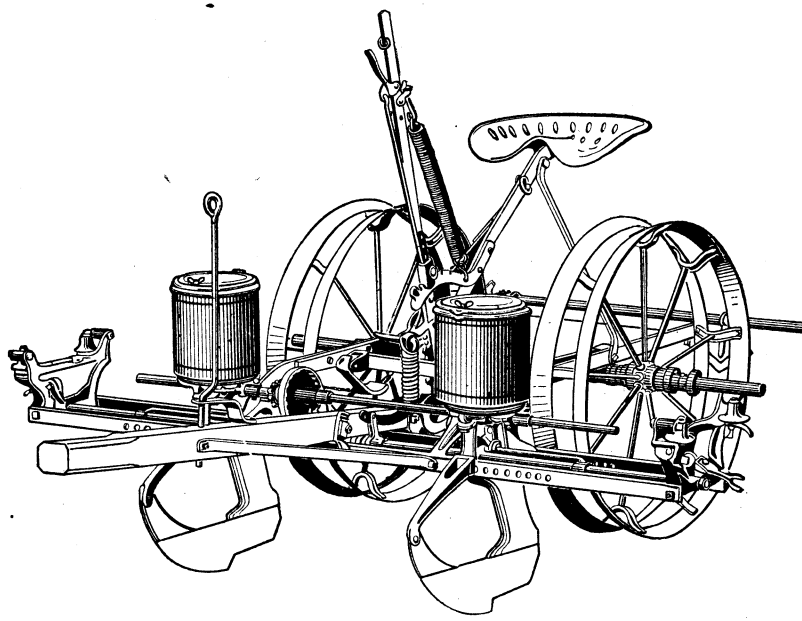

FIG. 1.—A double-row bean or corn planter.

dropping a bean every 2 to 3 inches in the row. If planted this way the beans will ripen a little earlier and more evenly and the quality will be more uniform. If the ground is so foul as to require extensive cultivation, the beans should be planted in checks with the hills 30 inches apart each way. About 7 beans should be planted in each hill. If planted in this way the beans can be cultivated each way. Land that will require only a medium amount of hoeing may be planted in rows 30 inches apart with hills about 15 inches apart in the rows. An average of 7 beans should be planted in each hill. On very steep land the rows should run straight up the hill. If the surface of the field to be planted slopes in more than one direction, it is frequently advisable to change the direction of the rows so that

they will run straight up the hill on the steepest parts of the fields. This makes it much easier to cultivate and harvest the beans.

The double-row bean and corn planter is used almost exclusively for planting the crop. An excellent type of planter is shown in figure 1. This planter may be adjusted to plant in rows from 28 to 44 inches apart. By using a special 30-inch wire it will also plant the hills in 30-inch cross checks. The feed plates may be made to drop the desired number of seeds in each hill by regulating their speed. The planter is also equipped with an automatic hill-drop attachment which drops the hills from 17 to 52 inches apart in the row.

A hand corn planter is often used for planting where only a small acreage is to be grown. The ground is marked off in checks about 30 inches square and the beans dropped at the intersection of the marks. An experienced man can plant from 4 to 7 acres a day by this method. If the ground is free from weeds, so that but little cultivation is necessary, the seed is often planted in drill rows with either a bean planter or an ordinary grain drill. Of the two, a bean planter which has a drill attachment is the more desirable.

A grain drill having feed cups which will handle beans may be used with fair success. An 11-row grain drill with spaces of 7 inches between the grain tubes can be adjusted for drilling beans in rows 28 inches apart by stopping up all of the feed cups except the second, sixth, and tenth. The machine is so regulated as to plant the seed from 3 to 6 inches apart in the row.

The depth at which the beans are planted depends upon the character of the soil and the weather conditions. They are not planted so deep in dark, heavy soil as in a lighter soil. Neither can beans be planted to a very great depth during cold, damp weather without injuring the stand. The safe plan is to plant just deep enough for the seed to lie in moist earth, for an even stand of strong, healthy plants is one of the first requirements of a good bean crop.

INOCULATION.

For the successful culture of beans there must be nodule-forming bacteria in the soil. If these bacteria are present they form on the roots of the bean plants little lumps called nodules. By the aid of the bacteria living in the nodules the bean plants are able to assimilate atmospheric nitrogen. Without the help of these bacteria they must obtain their nitrogen from the soil. If the nodule-forming bacteria are not present in the soil they may be supplied in one of two ways: (1) Pure-culture inoculation and (2) soil inoculation.

Pure-culture inoculation material is furnished to farmers by the Oregon Agricultural College, the Washington State College, and the

University of Idaho. The United States Department of Agriculture also furnishes it in small quantities for demonstrational purposes. Directions always accompany the pure-culture inoculating material.

Beans may be inoculated by using soil in either of two ways: (1) The beans to be treated are placed upon a tight floor, sprinkled with water, and shoveled over until each bean is wet. Only just enough water should be used to wet the beans. The wet beans are then sprinkled with pulverized soil taken from a field or garden which had in the previous year produced beans with nodules on their roots. About one pint of soil is sufficient for a bushel of beans. After applying the soil the beans are again shoveled over until some of the dirt has stuck to each bean. (2) By the second method the inoculating soil is placed in a bucket of water and stirred until the soil lumps have disappeared. The seed is then sprinkled with the dirty water and thoroughly stirred with a shovel to insure the wetting of each seed. From 1 to 1½ pints of water should be sufficient for a bushel of seed.

In using either of these methods care should be taken to use only sufficient soil to place a very little on each seed. If too much soil is used it is difficult to get the seed through the drill. Since only a small amount of soil is used, it should be gathered very carefully. Only soil should be used which has been in direct contact with bean plants having plenty of nodules on their roots. It should have been gathered during the previous summer and stored in a cellar or damp shady place until it is used. It should also be understood that inoculation will do little or no good except on land which never produced beans before or on land where beans have partially failed because of the absence of the nodule-bearing bacteria. On land which has recently produced beans successfully it is not necessary to inoculate the seed.

QUANTITY OF SEED PER ACRE.

The quantity of seed required per acre depends upon the size of the beans and also upon the manner of seeding. The pea-bean varieties, such as the Little Navy, the Lady Washington, and the Red Miner, require from 24 to 30 pounds per acre when planted in checks 28 inches square. If planted in drills or checked 30 to 36 inches apart only 20 to 25 pounds of seed will be necessary. The larger seeded varieties require more seed per acre than the smaller varieties.

It is considered very essential that the number of plants grown on a certain area be sufficient to maintain a proper balance between the soil moisture and the moisture requirements of the plants. If this balance is properly maintained the beans ripen evenly and a uniform crop is produced. In the sections where beans are being grown at

present, from 6 to 8 seeds in each hill produce the proper number of plants. If a smaller number of seeds is planted in each hill there is often moisture enough in the ground to keep the vines growing late in the fall, and the late beans are sometimes damaged by early fall frosts. This problem must be worked out, however, for each locality having different soil and moisture conditions.

CULTIVATION OF THE BEAN CROP.

A thorough preparation of the seed bed, as indicated above, leaves the soil in excellent tilth, destroys most of the weeds, and hence materially lessens the cultivations necessary after the beans are planted. The number of cultivations depends upon so many factors that no fixed rule can be made to apply to every case. For this reason the statements which follow must be taken in a general sense.

If the ground is very foul the shovel cultivator is run immediately behind the planter. In two or three days, or just before the plants begin coming through the ground, the field is cultivated with a light drag harrow. The harrow destroys the small weeds, levels the surface of the ground, and puts the soil in splendid condition to be cultivated as soon as the plants are large enough. If weed seed germinate at the same time as the beans, the ground is harrowed again after the plants are up.

Some growers fear to use the harrow, lest they injure the stand by breaking off the young plants. Very little damage is done, however, if the seed bed has been so well prepared that the ground is level and free from clods and if a light harrow is used. Several growers near Weston, Oreg., have followed this practice for a number of years with satisfactory results.

One harrowing, either before or after the plants are up, is sufficient if the ground is comparatively free from weeds. It should be done when the weeds are most easily destroyed. Two or three additional cultivations during the growing season are usually necessary. The soil is not stirred to a depth of more than 2 or 3 inches, for the reason that the bean is a surface feeder and deep cultivation is liable to disturb the rootlets and thus weaken the plant by diminishing the food supply.

The implements employed in cultivating corn are the ones usually used in bean culture. Sweeps are substituted for the shovels, as they are better adapted to shallow cultivation. Level cultivation is practiced at all times. Cultivation is discontinued when the vines begin blooming, for the flowers are easily knocked off, and late stirring of the soil keeps the plants growing, making them liable to injury by early fall frosts.

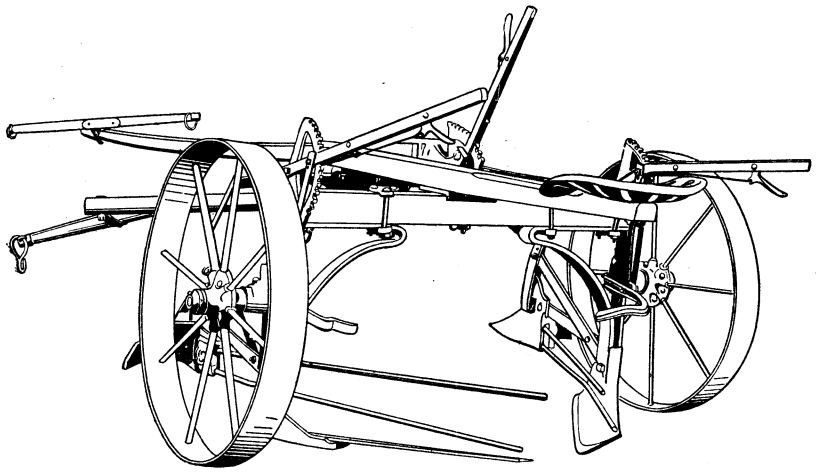

FIG. 2.—The double-row bean cutter generally used for harvesting the crop.

HARVESTING THE BEAN CROP.

In the bean-growing districts of Nez Perce and Latah Counties, Idaho, the bean harvest usually begins about September 10. The date varies, however, from August 25 to September 20, according to the season, the altitude, and the varieties grown.

A double-row bean cutter similar to the one shown in figure 2 is generally used for cutting the crop. One man with two good horses can cut from 12 to 14 acres per day with a machine of this kind. The double-row sled bean cutter shown in figure 3 is also a very satisfactory implement, especially on steep land, as the runners tend to prevent slipping down the hill. This implement requires three horses.

When the pods have turned yellow and before they have dried out the vines are cut just below the surface of the ground. Either of the cutters here described cuts two rows at a time and forces the vines into one windrow. Two men with pitchforks follow immediately behind the cutter and place three of the windrows into one row of piles.

The plants are left piled in the field until the vines are thoroughly dry. It seldom takes more than two or three days for them to become dry enough to be hauled to the bean huller or stacked in the field or in sheds. Stacking in the field before thrashing is growing in favor, since in this way a larger acreage may be handled without danger of damage from rain. It is during the time the beans are lying in piles between cutting and thrashing that there is danger of damage from rain. If stacked, such damage is not liable to occur, as the stacking can begin within a couple of days after cutting and the beans are left in piles only a short time. Another advantage

of stacking is that the vines go into a sweat soon after they are stacked and do not become thoroughly dry for three or four weeks after the sweating process begins. While in the sweat the vines, pods, and seed become toughened, and there is less danger of cracking than if thrashed directly from the field.

The side-delivery hayrake is now coming into use in harvesting beans in Latah and Nez Perce Counties, Idaho. When this implement is used the beans are allowed to dry partially in the windrow as left by the bean cutters. Two of these windrows are then thrown together by driving the rake over the field. Another windrow is then combined with the two by driving the rake on the next windrow but in the opposite direction, thus making a windrow composed of six bean rows. If the weather is favorable, the beans are hauled direct from these large windrows to the thrasher, stack, or bean shed. If the weather is unfavorable, the beans are piled into bunches in a manner similar to that described above.

Stacking.—The stacks are built on a layer of straw 12 or 14 inches thick in order to keep the pods from coming into contact with the ground. The straw also catches the seeds which are trampled out during the stacking process. The beans are separated from the straw by running both through the huller. The stacks are kept dry by covering them with heavy canvas. An excellent way to protect the beans until thrashed is to cover them with straw. On the top of the stack the covering should be 12 to 15 inches deep. The straw is held in place by a network of wires or binder twine. Making the cover waterproof is important, for a leak may discolor the beans from the top to the bottom of the stack.

When handled properly beans are no more liable to damage from rain than grain crops. If a rain should come before the beans can be stacked they are turned as soon as the ground dries. The pods

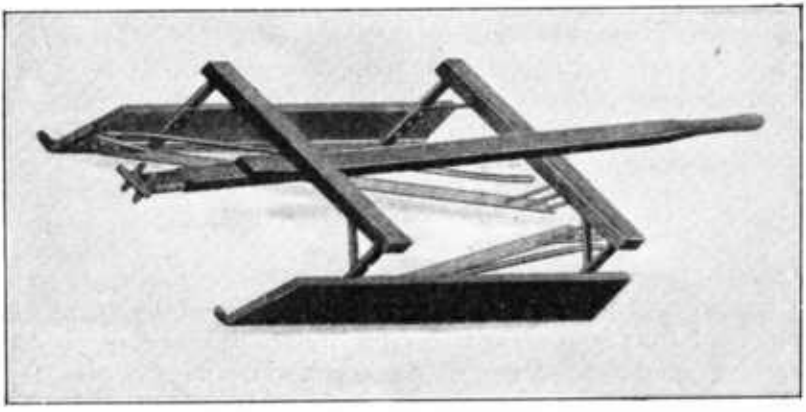

FIG. 3.—A double-row sled bean cutter.

must lie but a short time on the wet earth, as the seeds absorb moisture readily and are liable to become discolored. Care must also be exercised in handling the vines after they become thoroughly dry, for the pods crack open easily and much loss may result from shattering.

A bean crop may sometimes ripen so late in the season and rains may come so frequently that it is impossible to get the vines dry enough to stack in the usual manner. Crops caught in this condition have been saved by stacking in the driest possible condition in narrow stacks about 10 feet wide. During the construction of the stack, poles, rails, or fence posts are placed in it to give the beans ventilation. They are placed lengthwise of the stack and are separated by layers of beans from 18 to 24 inches thick. As the stacks must stand until the following spring or summer before the beans can be thrashed, they must be well covered.

THRASHING THE CROP.

The thrashing is usually done with a bean huller, a machine designed to minimize the loss from cracking. Good work may be done with a grain separator, provided the vines have remained in the stack long enough to be in the sweat and the speed of the cylinder is slowed down to 300 or 400 revolutions per minute, the speed depending on the diameter of the cylinder. All but one row of the concave teeth and half of the cylinder teeth are removed, the separating parts of the machine are run at the same rate as when thrashing grain, and none of the thrashed beans are allowed to pass from the elevator into the cylinder a second time.

In districts where beans are a staple crop the bean hullers make a regular fall run, the same as grain thrashers. The charge for thrashing is usually 30 cents per sack, full sacks weighing from 140 to 150 pounds. This makes the charge about 20 cents per hundredweight. The charge includes all labor connected with thrashing except hauling the vines from the field to the machine in case they are not stacked. Growers who have only a small acreage or who live in a community where there are no hullers do their thrashing with a grain separator or by means of a flail. Two men can flail out and clean up about 1,800 pounds per day.

MARKETING THE BEAN CROP.

Cleaning and grading in order to get a uniform and attractive product are very important items in the marketing of dry beans. As far as the farmer is concerned, this preparation usually ends with the thrashing operation. Many of the grain warehouses in the bean-growing districts are equipped with special machinery for this work. The farmer delivers his beans to the warehouse just as they come

from the bean thrasher. He receives a load check, and his beans are kept in a separate pile. He then has the choice of selling them in this condition, or he can have them recleaned, scoured, separated into two grades (large and small), and placed in sacks weighing 85 pounds each. After this work is done, the farmer receives a negotiable warehouse receipt in exchange for his load receipts. The minimum charge for recleaning, scouring, and grading is $2 per ton.

Before the war affected prices the growers usually received from $3 to $4.50 per hundredweight, the price varying according to the size and quality of the product. The smaller beans are most in demand and sold at a price from 50 to 75 cents per hundredweight higher than the larger beans.

It is sometimes necessary to hand-pick the crop on account of discolored beans if the harvest season is damp. The weather conditions are usually such, however, that hand picking is not necessary if the crop is handled properly. The operation of hand picking is greatly facilitated by a small machine, operated by foot or other motive power, and consisting of a canvas belt 7 or 8 inches wide passing over rollers driven at a low speed. The beans are fed to the belt from a hopper and as they are carried along the pickers remove the discolored seed and foreign particles. The sound beans pass to the end of the canvas and drop into a sack or other receptacle.

VARIETIES OF BEANS GROWN.

The three varieties of beans most extensively grown in the regions mentioned are the Lady Washington, the Little Navy, and a variety locally known as the Red Mexican, or Red Miner. Many strains of the Little Navy have different minor characteristics. They are grown under such names as Banner Leafless, Prolific Tree, and Prize Winner. The Red Mexican, or Red Miner, is the earliest of the three varieties and is preferred for late plantings or high altitudes where the season is short. All three of the most popular varieties are somewhat spreading and branching in character; they are very vigorous growers and extremely hardy. The Little Navy is especially prized for its hardiness, productiveness, evenness in maturing, and its uniformly well-filled pods.

IMPROVEMENT OF THE SEED BY SELECTION.

By carefully studying a field of maturing beans one will observe a wide variation in the individual plants. It will be seen that some of the plants are mature, while others are still green; that some are heavily laden with well-filled pods, while others bear only a small number of seeds. On account of this variation it is possible to

greatly improve the crop by careful seed selection. The object of such selection is to increase the yield and vitality of the seed, to improve its quality, and to produce plants that will ripen evenly. In certain localities it is also desirable to select early-maturing plants in order to shorten the time required for maturing the seed. It is impossible, however, to obtain permanent results unless such selection is practiced every year, for bean plants have a strong tendency, if selection ceases, to return to the original type.

A practical method of seed improvement used by the most successful plant growers is as follows: In starting the work a large number of plants heavily laden with ripe pods are selected from the field at the time of maturity. The plants are taken from parts of the field where the stand is uniform and from soil which is representative of the general soil conditions. Plants from the outside rows or where the stand is poor are not representative and must not be used in seed selection.

The plants are pulled by hand, removed from the field, and carefully inspected to secure the 25, 50, or 100 which are best. These are thrashed individually and the beans from each plant put in separate paper bags, which should be numbered.

The following year these selected seeds are planted by hand, a separate row to each paper bag. Toward harvest time this will be the most interesting plat on the farm, since the grower will soon see that when selecting his best plants the preceding fall in many cases he did not "know beans." Quite a number of rows in this plat will be found to have produced progeny which are distinctly inferior in some respect. Here the advantage of these "progeny rows" will be apparent, since the grower is able to discard the bad rows entirely, whereas if he had not planted the seed from each selected plant to itself it would be practically impossible to remove the poorer types by roguing. One or a few rows will be found to be markedly better than the rest, and all of these good rows should be saved for next year's seed plat. The remainder of the seed plat, after discarding a few rows which may be distinctly bad, can be used to plant the field.

By one year's individual selection a strain can be established which may be kept fairly pure by discarding all the inferior plants from the seed plat. The plat should be sown each year and should be large enough to furnish all the planting seed desired. The extra labor in thrashing which this selection plan requires will come at a time of year when it can be spared, since the selected plants may be stored unthrashed for a while. The labor of hand planting will be richly repaid by the greater producing value of a selected strain of beans.

BY-PRODUCTS OF THE BEAN-GROWING INDUSTRY.

The value of bean straw as a rough feed is not fully appreciated by most growers. While a few farmers are feeding their bean straw, most of it is burned immediately after thrashing. Others allow it to partly decay in large piles and then use it as filling for ditches or as a fertilizer. When not allowed to become damp or moldy, bean straw makes a splendid roughage for either sheep or cattle, and when fed in conjunction with grain it is a very good substitute for hay.

Bean straw is superior in feeding value to wheat hay and but little inferior to barley hay. Beans ordinarily will yield from one-half to three-fourths of a ton of straw per acre. Taking as a basis the price paid before the war for wheat hay in the bean-growing section, bean straw should be worth from $5 to $8 per ton when fed on the farm and the manure returned to the soil.

While there is but little waste caused from decay or discoloration of the seed during harvest, sometimes there is a quantity of cull beans due to the splitting or cracking of the seed during thrashing. These culls make very good hog feed when thoroughly cooked and fed in conjunction with other grain.

CONCLUSIONS.

Thousands of acres of land are lying idle as summer fallow each year in eastern Washington, eastern Oregon, and northern Idaho that are well adapted to the growing of beans. Twenty years' experience shows that about as good cereal crops can be grown following beans as after an ordinary summer fallow. The cultivation of the bean crop replaces the work necessary to care for the fallow, and leaves the soil in excellent condition for seeding winter wheat. The crop is also harvested in ample time to permit fall seeding.

Beans do not seriously compete with wheat for labor, and the two crops can be grown with practically the same equipment. Approximately $150 worth of extra machinery is needed to plant, harvest, and cultivate from 70 to 80 acres of beans instead of cultivating the land as summer fallow. With the wage for man and horse labor which prevailed before the European war it required about $6 more per acre to grow, harvest, and market a crop of beans than it did to summer-fallow an equal area. Since beans yield on the average about 800 pounds per acre, the gross return per acre would be approximately $24 if sold at 3 cents per pound. At this price in districts adapted to bean culture, beans were approximately $18 per acre more profitable than summer fallow, and at present prices a greater profit would be shown.

Generally speaking, the soils of the bean-growing districts are rich in all of the mineral elements necessary for plant growth. Under

such conditions the maintenance of soil fertility will depend almost entirely on keeping up the organic matter of the soil. This is not easily accomplished when beans and cereal crops are grown exclusively. Stubble always should be plowed under instead of being burned. The plowing under of partially decayed bean and wheat straw will also do much toward keeping the soil in a productive condition. The decayed straw should be scattered rather thinly over the grain stubble in the fall. It should be thoroughly worked into the surface soil with a sharp disk harrow and plowed under as soon as possible after the first autumn rains. The disking causes the straw to mix thoroughly with the soil at the time of plowing instead of forming a layer in the bottom of the furrow.

The permanency of the argriculture of the present bean-growing districts would be increased materially by introducing clover (biennial sweet, red, and alsike) or alfalfa into the crop rotation. The organic matter of the soil is gradually becoming depleted under the two-year rotation of wheat and beans, and the introduction of one of the above crops would aid in correcting that condition.

○